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A CRITIQUE OF PROFESSOR WIRTH'S METHODS OF MEASUREMENT OF ATTENTION

By L. R. GRISSLER

I have been working, for the past two years, upon the problem of the measurement of the degree of attention; and I have sought to approach the problem in the way that has already led to success in the case of intensity of sensation, by the assignment of numerical values to introspectively differentiated degrees of clearness. The problem has already been attacked by experimental psychologists, and notably by Professor W. Wirth, of Leipzig. Wirth's methods are entirely different from my own: but his general formulation of the problem, as that of measurable degrees of clearness, is the same. As I have found Wirth's articles both difficult and obscure, and as my criticism of his work must be given with some fullness if it is to be itself intelligible, I have thought it well to devote a special paper to the discussion of his contributions to the subject.

There is a difficulty at the outset, due to the fact that Wirth expresses himself only incidentally as to the relation of the field of attention to the field of consciousness. Wundt has made us familiar with the distinction between attention and inattention, apperception and perception, inner point of regard and inner field of regard. Wirth, on the other hand, appears (although I wish to speak on this point with great caution) to identify the range of attention with the range of consciousness. He aims to give "a precise determination of the range of simultaneous mental processes."¹ The title of his article in the Wundt *Festschrift* is "Zur Theorie des Bewusstseinsumfanges und seiner Messung." He speaks of the "Versuch einer Wiedergabe des gesamten Bewusstseinsumfanges."² Phrases like these seem to show at least that he is concerned with a total simultaneous consciousness, with both focal and marginal processes, even if they do not in themselves show that he draws no definite distinction between centre and periphery of consciousness. But we find, later, a passage like this: "the mere determination of the possible number of (tachistoscopically) isolated elements in maximal clearness does not at all show how high the absolute clearness-degrees may rise, or how many objects of the same clearness may be added to the average number of five isolated single objects, provided that all of them together form a familiar, associatively related whole."³ Or again: "our measure of range really presupposes only a uniformly graded and highest possible average clearness of the whole complex."⁴ Here we have, appar-

¹*Philosophische Studien*, xx, 489.

²*Op. cit.*, 493.

³*Op. cit.*, 524. "Durch die Feststellung der möglichen Zahl derartig (tachistoskopisch) isolirter Elemente in maximaler Klarheit ist jedoch noch gar nichts darüber bestimmt, wie hoch sich nun die absoluten Klarheitsgrade belaufen bzw. wieviele Objekte noch in der gleichen Klarheit wie bei ca. 5 isolirten Einzelobjekten zu diesen hinzutreten können, wenn sämtliche Objekte zusammen ein geläufiges, unter sich associativ verbundenes Ganzes ausmachen."

⁴*Op. cit.*, 524. "Zunächst ist ja eigentlich nur die gleichmässig abgestufte und im Mittel möglichst erhöhte Klarheit des gesamten Complexes zu unserer Messung des Umfangs vorausgesetzt."

ently, an identification of attention and consciousness. And this inference is borne out by a passage in which Wirth discusses the relation between the apperceptive and perceptive regions of a simultaneous consciousness, and declares outright that there is no sharp difference between the two, but that on the contrary there are a number of transitional stages as we pass from the higher to the lower level. It is evident, he says, to unaided introspection "that the contraposition of an apperceptive and a perceptive region is not to be thought of as a mere dual division of consciousness. Within the simultaneous whole, several stages of attention and of clearness may always exist side by side, according as at any moment a larger or smaller number of unitary complexes forms the immediate experience of the subject. Although under certain conditions, which favor a kind of dual division, it is possible that a region, to which a fairly uniform attention is given, may be opposed to a 'background' or 'periphery' of consciousness, to which attention is as uniformly denied, nevertheless the concept of apperception ordinarily denotes a general direction of the process which goes on over the whole field, though at different places with unequal completeness."¹ Apperception is thus, as it seems, simply a general tendency to conscious self-realization, common to all the contents of a consciousness, but carried farther in the case of certain mental processes than in that of others simultaneously present. The antithesis of 'dunkel bewusst' and 'klar bewusst' practically lapses, as antithesis, and the difference between perception and apperception becomes merely a matter of degree. If it is objected that, even in Wundt himself, this difference has never been anything more, we reply that while the objection may be formally sound, in terms of a strict definition of the conscious states known as clear and obscure, nevertheless the distinction has played so important a part in the Wundtian system as to be, to all intents and purposes, a distinction of kind. This generic, Wundtian difference seems to be given up by Wirth, without defence or discussion; and we may add that Wundt himself, in his brief discussion of Wirth's experiments,² vacillates between the expressions 'range of consciousness' and 'range of attention' as if he too saw no reason to distinguish them.

The question at issue, however, is more than a question of personal belief or of an individual psychological system; it is a question of fact, of observation. That Wirth would have done well to face it as a question of fact will come out, I believe, in the course of the present paper. The above interpretation of Wirth's attitude is offered with all reserve, since his language—if I understand it aright—is not always consistent. I turn now to a consideration of his experimental investigations.

Of the three sets of experiments reported³ the first is of a preliminary character, and is of no importance for the determination of degrees of clearness. In these experiments, a standard visual complex of 25

¹*Op. cit.*, 493. "Hierbei zeigt sich vor allem noch, dass die Gegenüberstellung einer apperceptiven und perceptiven Region nicht etwa bloss als eine einfache Zweitheilung des Bewusstseins zu denken ist. Innerhalb des simultanen Ganzen sind jederzeit mehrere Stufen der Beachtung und der Klarheit neben einander möglich, je nach der grösseren oder geringeren Zahl von Einheitsbildungen, auf welche sich das Subject augenblicklich im unmittelbaren Erleben bezieht. Wenn auch unter Umständen in einer Art von Zweitheilung eine ziemlich gleichmässig beachtete Region einem ähnlich gleichmässig unbeachteten 'Hintergrunde,' bezw. einer 'Peripherie' des Bewusstseins gegenüberstehen kann, so bezeichnet doch der Begriff der Apperception mehr eine allgemeine Richtung des Processes, welcher innerhalb des ganzen Blickfeldes an verschiedenen Stellen in ungleicher Vollkommenheit durchgeführt ist."

²*Phys. Psych.*, III, 1903, 358-360.

³*Philos. Stud.*, XX, 1902, 635-659; *Psych. Stud.*, II, 1906, 30-88; A. Kästner und W. Wirth, *ibid.*, III, 1907, 361-392, and IV, 1908, 139-200.

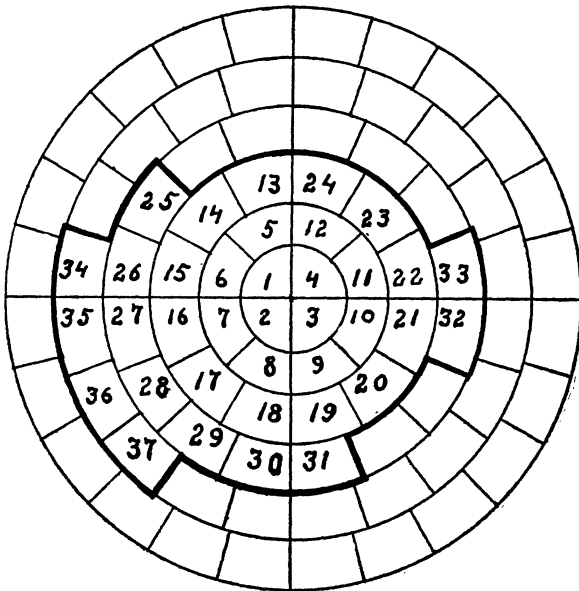
or less small geometrical objects was observed, with maximal attention, until all its elements had been clearly apprehended. During a short interval, usually of less than a second, the complex was slightly varied, in one or several different places unknown to the observer. Then it was tachistoscopically re-exposed for another fraction of a second, and the observer was asked to say whether, and if possible where, a change had taken place. Wirth's argument is as follows: "So far as, under these variable conditions, a correct judgment of difference remains possible, so far at least does the range of the simultaneous visual consciousness extend. But the difference necessary, at any given point, to arouse this correct judgment of difference, or in other words the differential limen under these special conditions of attention, is at the same time a measure of the clearness-degree which obtained at that particular point in the standard complex".¹ That is to say, if the change made at a certain place in the complex is noticed during re-exposure, then the object was in consciousness at some moment of the primary exposure; and the amount of change needed to arouse notice is inversely proportional to the degree of clearness of the mental content. The results show that, if the complex contained only 12 or 13 figures, any change in them could always be judged correctly; whereas, if the complex consisted of 25 figures, many errors occurred. With a momentary original exposure of a standard complex of 3 to 5 figures, changes in the re-exposure field were recognized with correspondingly greater or less certainty. Thus the results confirm and extend those of previous tachistoscopic experiments upon the range of attention proper.

After this preliminary investigation, Wirth comes back to the "problem of the completest possible determination of the range of consciousness",² which leads him more especially to "a quantitative determination of the simultaneously present clearness-degrees or degrees of consciousness of the greatest possible number of elements".³ Nothing is said of the apperceptive and the perceptive regions; and it is only by a close examination of the experimental methods and results that we shall be able to decide whether Wirth has measured different degrees of clearness within the apperceptive region only, or whether he is dealing with the whole series of assumed transitional steps between the upper and the lower levels of consciousness. Wirth devised a special apparatus, whose main features are as follows. The field of vision for the left eye consisted of the funnel-shaped and uniformly illuminated surface of a glass cone 50 cm. in diameter at the base and 25 cm. high. The left eye was placed at the centre of the perimetrical field. The whole surface was divided into 6 concentric rings, the peripheral ring being again divided into 24 regions, the next into 20, the next into 16, the next into 12, the last into 8, and the inner disc into four regions. Of the 84 regions thus demarcated, 37 were selected for experimentation. The arrangement is shown in the Fig. By reference to this schema, the point of change could be easily identified. The conical surface was observed continuously,

¹Philos. Stud., XX, 593 f. "So weit sich unter den übrigen, bereits bekannten Bedingungen noch ein richtiges Unterschiedsbewusstsein bei einer solchen Variation mit Sicherheit einstellt, so weit reicht mindestens der Umfang des simultanen optischen Bewusstseins. Die Differenz aber, welche zur Erzielung eines solchen Unterschiedsbewusstseins an einer bestimmten Stelle notwendig ist, also die Unterschiedsschwelle unter diesen speciellen Aufmerksamkeitsbedingungen, ist zugleich ein Mass des Klarheitsgrades, welcher an dieser Stelle bei der Verteilung innerhalb des betreffenden Complexes herrscht."

²Psych. Stud., II, 30 f.; "die Aufgabe einer möglichst vollständigen Bestimmung des sog. Bewusstseinsumfanges."

³Op. cit., 31; "der quantitativen Bestimmung der gleichzeitig vorhandenen Klarheitsgrade oder Bewusstseinsgrade möglichst vieler Elemente."



with different distributions of attention, while by the manipulation of lenses and mirrors any one of the 37 regions could be gradually changed until its brightness was noticeably different from that of the rest. The first problem, then, was to establish the 'normal' differential limen for each region while the apex was fixated and the particular region was observed with maximal attention. If, for example, the brightness of the whole field of vision at a given moment was 174.5 photometric units, while the observer was attending to region no. 2, and if the additional brightness necessary for the region to become just noticeably different was 29 photometric units, and the duration of the change was 6.75σ, then the normal limen for region no. 2 was $\frac{29 \times 6.75}{174.5} = .91$. The values for

each of the 37 regions were similarly determined. The next question was to find out how the normal limen was changed by varying concentration of attention, and how the changes could be made to express or measure degrees of clearness. To answer it, Wirth divided the normal limen of any given region by its 'distraction' limen, that is, by a limen for the same region with a prescribed direction of attention. "A comparable value for the degrees of clearness (*Beachtung*) realized with a total distribution of attention over the various elements, each having its variously favorable position in the complex, may evidently be obtained without serious error if we divide the limen for maximal attention to a known region of change by the liminal value (for the same region) resulting from the method without knowledge, that is, from the method employed for the determination of the range (of consciousness)".¹ Or, more explicitly: "a more delicate differential or

¹Philos. Stud., XX, 598. "Einen vergleichbaren Werth der Grade der Beachtung, welche für eine und die nämliche Gesamtvertheilung der Aufmerksamkeit mit

variational limen will correspond to a higher clearness degree; and the ratio of this limen to the normal limen for the same region as known in advance and made the object of attention will offer the greatest approximation to a comparable measure of degrees of clearness."¹ Thus, to return to our previous example of region no. 2; if we determine its distraction limen, while attention is distributed over the whole area, we find the value $\frac{30 \cdot 3 \times 25}{146 \cdot 4} = 2.06$. The degree of clear-

ness corresponding to the distraction limen 2.06 is then expressed by the ratio 0.91:2.06. The clearness degrees for the other regions are determined in the same way. We thus obtain 37 different ratios, which are made comparable by reduction to the same basis of 100; *e. g.*, in the case of region no. 2, the proportion 0.91:2.06=100:*x* results in the value 226 as the clearness index for a totally distributed attention. Wirth has determined in this manner the clearness indices of all the 37 regions for 6 different distributions of attention, and has presented them in 6 different schemata of the kind shown in the Fig., each region containing a ratio which represents its clearness for a certain distribution of attention. As to the psychological interpretation of these schemata, he says simply: "the value of these diagrams is quite independent of our psychological interpretation, which might, *e. g.*, be given as well in terms of purely dispositional factors."² Nevertheless, he certainly assumes that the numerical values of the schemata are, in some way and to some extent, definite quantitative measures of degrees of clearness. In order, then, to determine whether and in how far the results may be accepted as indications of differing clearness-degrees, we must examine the diagrams more closely. And we begin by considering them, so far as possible, from what we conceive to be Wirth's own point of view.

Wirth gives, first, a schema of minimal normal values,³ which he employs for the calculation of the ratios with the six different distributions of attention. We should expect that these values would show normal characteristics as regards their magnitude, their relative frequency, and their spatial distribution. Now the lowest of them is 74, the highest 173, the general average 119, and the mean variation 19.3. The most frequent values (11) occur between 91 and 99, while 26 (or almost three-fourths of the 37) occur within the limits of 74 and 116, and the 11 highest values range between 123 and 173. The most regular spatial distribution is evinced by the four quadrants constituting the three innermost and complete concentric areas, and consisting of 24 regions. The left lower quadrant has the lowest average value, 89±5, and the right upper quadrant the highest, 126±7; the other two are nearly equal, 100±7 and 102±7 for the left upper and right lower quadrants respectively. However, if we look at the extreme values in each of the five concentric areas, we find that they range, as we travel in the centrifugal direction, between 91 and 107, 74 and 137, 87

verschieden günstiger Stellung der einzelnen Elemente zu Theil werden, gewinnt man dann offenbar ohne grossen Fehler, wenn man den Schwellenwerth bei maximaler Beachtung der wissenschaftlich variirten Stelle mit dem Schwellenwerth dividirt, der bei unwissenschaftlichem Verfahren, also den eigentlichen Umfangsbestimmungen, gewonnen worden ist."

¹Psychol. Stud., II, 37. "Dem höheren Klarheitsgrade wird hierbei eine feinere Unterschieds- bzw. Veränderungsschwelle entsprechen, deren Verhältniss zu der 'Normalschwelle' für die Veränderung des nämlichen im voraus bekannten und maximal beachteten Elementes die grösste Annäherung an ein vergleichbares Mass des Klarheitsgrades bieten dürfte."

²*Op. cit.*, 73. "Der Wert dieser Karten ist ganz unabhängig von unserer psychologischen Deutung, die z. B. auch im Sinne rein dispositioneller Verhältnisse erfolgen könnte."

³*Op. cit.*, 71, Fig. 8.

and 137, 97 and 150, and 123 and 173. The difference in the central area is the smallest (16), in the next area the largest (63), and in the other areas nearly equal (about 50). In spite of these irregularities, Wirth thinks that "there appears, after all, to be a sufficient degree of uniformity in the minimal values"¹ to warrant their use as 'normal' values. He therefore proceeds to divide them by the 222 distraction values, obtained with the six different directions of attention. It is obvious, however, that, if the normal values themselves show so little regularity, the 222 ratios partly depending upon them must be still less uniform as regards magnitude, relative frequency and spatial distribution. Besides, they are further affected by the fact that, while a certain part of the visual field is fixated, and another part observed with greatest concentration of attention, a liminal change of brightness may be expected in any possible region. Surely, such complications do not promise very satisfactory results. We find, in fact, that of the 222 values the lowest is 86, the highest 216. The extremes occur in the parts attended to as well as in those distracted from. For convenience of comparison we have arranged the figures in Tables I and II under the heading *Range*. The second table differs from the first in having the 9 high values above 200 eliminated. If, now, these

TABLE I

Attention to—	TOTAL FIELD OF VISION RANGE AV. MV.		AREA ATTENDED TO RANGE AV. MV.		AREA DISTRACTED FROM RANGE AV. MV.	
Total Field	108-284	165 30	108-284	165 30	— — —	— — —
Left Half of Field	86-181	131 23	86-181	130 24	88-178	131 20
Right Half of Field	106-186	136 17	110-173	136 20	106-186	136 16
Left Upper Quadrant	103-206	138 20	103-171	127 18	105-206	142 20
Left Upper Periphery	91-302	147 28	135 — —	— — —	91-302	148 28
Fixation Point	93-162	123 15	— — —	— — —	93-162	123 15

TABLE II

Attention to—	TOTAL FIELD OF VISION RANGE AV. MV.		AREA ATTENDED TO RANGE AV. MV.		AREA DISTRACTED FROM RANGE AV. MV.	
Total Field	108-200	151 19	108-200	151 19	— — —	— — —
Left Half	86-181	131 23	86-181	130 24	88-178	131 20
Right Half	106-186	136 17	110-173	136 20	106-186	136 16
Left Upper Qu.	103-198	136 19	103-171	117 18	105-198	140 19
Left Upper Per.	91-192	141 22	135 — —	— — —	91-192	141 22
Fixation Point	93-162	123 15	— — —	— — —	93-162	123 15

¹*Op. cit.*, 72. "So ist schliesslich eine hinreichende Gleichmässigkeit der Minimalwerte vorhanden."

values are really expressions of degrees of clearness, we should expect to find a marked difference in their distributions; the low values ought to be found in the parts attended to, the high values in the other parts of the field. Or, if unknown and occasional errors or the irregularity of the normal values be allowed for, we should still expect to find the *average* values for the parts attended to lower than those for the rest of the field of vision.

The tables show no sign of such a distribution. Wirth himself explains the disappointing character of the results as follows: "the effort of the special activity to bring about the right distribution of attention makes itself felt as a competitive factor. With distribution of attention over the whole field, it is probable that the lowering of the clearness values is for the most part due to this disturbing factor. But the distribution of attention to a certain region also carries with it the possibility that a higher clearness-degree may be assigned to some particular point which, under the circumstances, happens to be the object of maximal attention. [For these reasons] the arrangement of the values within the observed area gives no constant picture of a determinate clearness-relievo in the visual field under steady fixation."¹ Such an admission seems, however, to be fatal to the whole investigation. If the difficulties encountered were so great as entirely to obscure the results, then the experimental method employed is not applicable to the problem in hand.

The third set of experiments upon clearness-degrees is reported by A. Kästner and W. Wirth. Here recourse is had, not to just noticeable brightness differences, but to a plainly supraliminal brightness-change. The clearness-indices are expressed by the times of quickest possible reaction to the discrimination of change. Otherwise the experimental arrangements remain the same as in the previous work. The following groups of experiments were made: I *a*, simple reaction with knowledge of the region to be changed and maximal concentration upon it (to furnish a series of 'normal' reaction times corresponding to the normal brightness determinations in the former investigation); I *b*, complete reaction, without knowledge, and with attention distributed over some one quadrant; I *c*, the same with total distribution of attention; II, the same, with attention upon a region in the left upper periphery; III, selective reaction without knowledge, attention being totally distributed, and the reacting forefingers being assigned either to the right and left halves of the visual field, or else the one to a particular region and the other to all other regions. "It seems justifiable to assume that a proportional change in the reaction time will occur, if at all, then assuredly in connection with its dependence upon the degree of clearness with which the motive to reaction is apprehended."² The clearness-index is expressed by a number which is found by multiplying the reaction time of a given region, with a certain distribution of attention, by a fraction whose numerator is a constant (the average of the 37 normal values, 223.8σ) and

¹*Op. cit.*, 87. "Indessen beginnt bereits die Anstrengung der besonderen Tätigkeit zur eigentlichen Verteilung der Aufmerksamkeit sich konkurrierend geltend zu machen. Bei der Verteilung auf das ganze Sehfeld fällt wahrscheinlich der Hauptanteil der Erniedrigung des Klarheitswertes dieser Störung zu. Doch trägt die Verteilung der Aufmerksamkeit auf ein Gebiet jederzeit die Möglichkeit in sich, einem beliebigen bei der Verteilung gerade maximal beachteten Punkt einen höheren Klarheitsgrad zukommen zu lassen, als ohne diese Verteilung. Die Art der Anordnung der Werte innerhalb des beachteten Gebietes lässt keine Konstanz eines bestimmten Klarheitsreliefs im Sehfeld bei festgehaltener Fixation auffinden."

²*Psych. Stud.*, III, 390. "Wenn irgendwo, so scheint nun gerade für die Abhängigkeit der Reaktionszeit vom Klarheitsgrade der Motivauffassung, die wir hier im einzelnen untersuchen wollen, eine solche proportionale Veränderung der zunächst von beliebigen Unterschieden der Raumlage modifizierten Reaktionszeiten angenommen werden zu können."

whose denominator is the normal average value (of 5 individual values) for a given region. Thus, if the reaction time for region no. 18 is 216σ, with total distribution of attention, while the normal average reaction for the same region is 221, then its clearness-index will be $216 \times \frac{223.8}{221} = 218$. Hence, with total distribution of attention, 218 represents the degree of clearness for region no. 18, independently of its position in the visual field.

The results of the normal reaction experiments are uniform. The times vary only between 200 and 245, and show a fairly regular distribution over the whole area. On the other hand, the results with various distributions of attention are so irregular that the authors are satisfied with the general comparison of the average values for the whole area, without, as a rule, giving due consideration to the large mean variations, or even distinguishing between the regions attended to and those not attended to. Their conclusion runs: "no matter how much the distribution of the times varies, over the whole visual field, for the different adjustments of attention, the general averages agree almost perfectly in cases of approximately equal practice; their mean is 282. This time is, therefore, in a certain sense the expression of a constant energy expended in the control of the whole perceptual field of possible motives to reaction,—an energy that, under the different distributions of attention, manifests itself in the time of preparation even for varying spatial positions; so that, on the average, a higher degree of expectation of a certain group of motives lowers correspondingly the preparedness of the observer for all the other possibilities." ¹ It is difficult to see what relation such a conclusion can sustain to the problem of measuring either the range of consciousness or the degrees of attentional clearness. Some of the irregularities are, it is true, more or less adequately explained, as due to special circumstances, while others are termed simply "Zufälligkeiten." ² The latter designation seems to apply, for instance, to the case of total distribution of attention, where the four regions of the most extreme concentric area contain not only the longest and the average reaction times of the whole series, but also the two quickest reactions of that particular series. However, it is not of vital importance that we should know the reason for the numerous irregularities. The fact that they occur at all, and prevent the appearance of the expected results, is sufficient to prove the inexpediency of the method. Indeed, in their closing sentence, the authors virtually admit the inadequacy of the investigation. "Further enquiry must determine how far a more detailed differentiation of the co-ordinations, with more than two possibilities of choice, may avail to furnish a more accurate representation of the clearness-relievo within any given group of motives to reaction." ³

Thus far we have sought to review Wirth's investigations entirely from what we regard as his own standpoint; and our conclusion is

¹ Psych. Stud., IV, 163. "So verschieden als die Verteilung der Zeiten auf das ganze Schfeld bei den verschiedenen Einstellungen der Aufmerksamkeit ist, so stimmen die Gesamtmittel bei ungefähr gleichen allgemeiner Übung fast vollständig überein und ergeben im Mittel hier 282. Diese Zeit ist also gewissermassen der Ausdruck einer konstanten Energie zur Beherrschung des ganzen Wahrnehmungsbereiches möglicher Reizmotive, die bei den verschiedenen Verteilungen der Aufmerksamkeit in der Vorbereitungszeit auch in verschiedener räumlicher Aufteilung zur Geltung kommt; so dass die grössere Erwartung der einen Motivgruppe die Bereitschaft für die übrigen Eventualitäten im Mittel um ein Entsprechendes herabsetzt."

² *Op. cit.*, 148.

³ *Op. cit.*, 200. "Es wäre nun weiterhin zu untersuchen, inwiefern eine weitere Differenzierung der Zuordnungen in einer mehrfachen Disjunktion ein genaueres Abbild des Klarheitsreliefs innerhalb eines Motivbereiches ergibt."

that he has failed to solve his problem. The difficulties of his method and the many factors that complicate his observations seem to obscure the real nature of his results and to rob them of any decisive significance. It may, however, be possible to give the results a new meaning by an interpretation from that standpoint which, in opposition to Wirth's, makes a sharper distinction between the apperceptive and the perceptive levels of consciousness.

There can be no doubt that Wirth's experiments have dealt with certain degrees of clearness. The question is whether they covered the whole range of a simultaneous consciousness, from the clearest region of apperception to the obscurest region of perception, or whether they were merely concerned with certain relatively small differences of clearness within the level of apperception itself. Wirth assumes that his low values represent a high degree of clearness. He has to admit, however, that his high values do not necessarily represent a low degree of clearness. They were due, at least in part, to distracting factors. While, therefore, the low values may possibly furnish a numerical statement of the clearness of processes on the apperceptive level, Wirth has been unable either to measure the clearness of processes on the lower level, or to prove the existence of his assumed transitional steps between the two levels.

Let us consider once more the liminal brightness-determinations obtained with various distributions of attention. The 222 values represent 100 actual ratios. Now Wirth certainly does not mean that each separate ratio measures a new degree of clearness, so that there are at least 100 stages between the two extremes of his experiments. If he had thought this, he would not have disregarded the large mean variations, and have contented himself with general averages. On the other hand, if his values do embrace the whole range of consciousness, and if they demarcate in a rough way some smaller number of intermediate steps, then we should expect them to fall into natural groups of greatest frequency, clustered around certain averages representing these steps, and thus to form a multimodal frequency curve. In this event, the number of such groups will indicate the number of intermediate steps, and the difference between their averages will be a rough measure of the size of the steps. But if we examine the total frequency distribution of the 222 values, irrespective of the various kinds of attention under which they were obtained, we find only the slightest indication of grouping between the values 90 and 160. The probable meaning of this we discuss later on. It is very significant that of the 100 different values only

2	occurred 7 times (namely 130 and 144)
1	" 6 " (" 146)
7	" 5 " (" 103, 110, 119, 125, 137, 149, and 157)
12	" 4 "
21	" 3 "
44	" 2 "

Although the figures vary, as was stated above, between the limits of 86 and 302, 90% of them (or 200 out of the 222) occur between 90 and 180; and, what is more, 75% (or 165) lie between 90 and 160. That there is no multimodal distribution may be easily shown by constructing a frequency surface, in which, *e. g.*, groups of 10 possible values are represented in each unit of the abscissa. The same fact is brought out in the following table:

Within the limits of 81 and 90 there occur 2 cases

91	"	100	"	"	10	"
101	"	110	"	"	26	"
111	"	120	"	"	31	"
121	"	130	"	"	32	"
131	"	140	"	"	26	"
141	"	150	"	"	30	"
151	"	160	"	"	21	"
161	"	170	"	"	13	"
171	"	180	"	"	12	"
181	"	190	"	"	6	"
191	"	200	"	"	4	"
201	"	302	"	"	9	"

Thus our expectation of finding natural groups of values is not realized. We find instead that the 222 (minus the 9 extreme cases above 200) group themselves around one general average of 136, with 75% of them clustering closely about 122. A similar distribution is found in Wirth's reaction times, as may again be seen from the construction of a frequency surface. This fact would seem to indicate that, during most of the experiments, the observer managed to maintain a fairly constant and fairly high degree of concentration, while during the remainder the difficulties of which we have spoken exercised a dominant influence upon the results. Such an assumption becomes still more plausible if we compare the frequency distribution of Wirth's reaction times with those of other experimenters upon the sensorial reaction. We may select for instance the results of Alechsieff as typical, since he also took sensorial or complete reactions to visual stimuli.¹ We call attention to the curves for his 4 observers A, K, F, and S. These observers were required to concentrate their attention maximally upon the stimulus. Their "Einstellung" thus differed as widely as possible from that required by Wirth. Nevertheless the distribution of their results is strikingly similar to Wirth's; so similar that the agreement can hardly be due to accident. It therefore seems fair to suppose that Wirth, after all, maintained a uniform concentration of attention upon the field of vision, and that his degrees of clearness—in so far as they are correctly indicated by his lower values—are only small variations upon the apperceptive level.

With this interpretation in mind we may come back to the slight indications of grouping between 90 and 160. Near our corrected average value of 122 there is, as has been said, a relatively large frequency of similar values. We notice further, small groups at 110 and 103, where we may perhaps assume slight rises in clearness above the common or normal level. We notice also small groups at the lower values 128, 137, 146, and 156, which in a similar way we may perhaps assume to represent slight decreases of clearness. The same thing appears on inspection of the reaction times. It is true that we are not here dealing with simultaneity in consciousness, since the values are taken from the different distributions of attention. And if separate curves are drawn for the separate distributions, they will be found to show both fewer and less marked deflections from their general apperceptive levels (especially in the case of the brightness-values, where all values above 160 should probably be eliminated). It would plainly be wrong, then, to lay any great emphasis upon these groups, in view of the extreme complications of Wirth's experimental conditions. They are at best, only very slight, and are mentioned merely in order to do full justice to the results.

¹ Philos. Stud., xvi, 1900, 1 ff.

All these considerations force upon us the conclusion that Wirth's numerical values, in as far as they may be admitted to measure degrees of clearness, refer to slight clearness variations on the apperceptive level only; that he has not measured the range of a total consciousness; and that he has given us no evidence of the existence of transitional degrees or steps between the apperceptive and the perceptive level. It may be added that, so far as can be seen without repetition of the experiments, Wirth's experimental arrangements were most unfavorable to a solution of his problem. All tachistoscopic experiments (and the conical field is, in essentials, tachistoscopic) tend to exaggerate the difference between the two main levels of consciousness. Under Wirth's conditions, the whole world of extraneous lights and colors was, objectively as well as subjectively, excluded from the observer's eye and mind. The difficulties of concentration of attention upon the various parts of the visual field, with maintenance of a constant fixation, must have required an almost hypnotic state of attention, in which the isolated tachistoscopic objects appealed to the observer with such exclusive force that the mental processes which would normally have occupied the perceptive level were driven towards or below the limen of consciousness. This is probably Wirth's justification for their neglect. But such an extreme and almost abnormal state of attention is, evidently, not the most favorable condition for the solution of his problem, in whatever form he meant this problem to be understood. It is too far removed from the conditions of daily life, where the most natural and frequent occurrence seems to be the more or less clear apperception of a single mental process or small unitary group of processes, upon a background of other, more or less obscure but still noticeable mental processes.

There are one or two other points that call for criticism. In the first place, practically the only observer, especially in the last two sets of experiments, was Wirth himself, so that there is no possibility of comparing results obtained from different individuals. The excuse offered is lack of time which, however, can hardly be accepted as valid. In the second place, comparison is the more necessary in this case since it is practically impossible to repeat the experiments anywhere except in the Leipzig laboratory. And yet they must be repeated, unless we agree that the methods are so faulty and so unpromising as to spare us the necessity of repetition. This, at any rate, is clear: that Wirth has failed to solve his problem. For, if we try to interpret his numerical values from his own standpoint, we find them meaningless; they are obscured or invalidated by complicating factors. And if we look at them from our own point of view, and eliminate into the bargain all doubtful cases, they appear to disprove his assumption of the existence of transitional steps between the apperceptive and perceptive levels. The main reasons for his failure seem to be uncertainty and ambiguity in the formulation of the problem; the impossibility of overcoming difficulties of observation; and the restricting conditions of his experimental arrangement, which was rather unfavorable than favorable to the type of consciousness under investigation.